

B13 a robot arm connected to the handling member, the robot arm comprising a first arm link having first and second end portion, a second arm link having first and second end portion, and a link retaining mechanism having a center line, the link retaining mechanism pivotably retaining the first and second arm links respectively at the first end portions of the first and second arm links and keeping parallel a first line and a second line, the first line being a line passing through the first and second end portions of the first arm link and the second line being a line symmetrical with respect to the center line with the line passing through the first and second end portions of the second arm link, the link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the link retaining mechanism, the first short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism and the second short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the link retaining mechanism, the second short and long links of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the link retaining mechanism, the second long link of the first joint cross linkage of the link retaining mechanism and the first short link of the first joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the link retaining mechanism under the state that the second long link of the first joint cross

linkage of the link retaining mechanism is crossed with the first long link of the first joint cross linkage of the link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the link retaining mechanism, the first short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the link retaining mechanism, the first long link of the second joint cross linkage of the link retaining mechanism and the second short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the link retaining mechanism, the second short and long links of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the link retaining mechanism, the second long link of the second joint cross linkage of the link retaining mechanism and the first short link of the second joint cross linkage of the link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism under the state that the second long link of the second joint cross linkage of the link retaining mechanism is crossed with the first long link of the second joint cross linkage of the link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the link retaining mechanism to each of the first and second long links of the first joint cross linkage of the link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the link retaining mechanism to each of the first and

B13  
second long links of the second joint cross linkage of the link retaining mechanism, the first short link of the first joint cross linkage of the link retaining mechanism integrally formed with and in axial alignment with the first long link of the second joint cross linkage of the link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the link retaining mechanism, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in axial alignment with the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of any one of the first and second arm links integrally formed with the second short link of the first joint cross linkage of the link retaining mechanism, the first end portion of the other one of the first and second arm links integrally formed with the second long link of the second joint cross linkage of the link retaining mechanism; and

a robot arm driving mechanism for driving the robot arm.

---

8. (Twice Amended) A robot arm mechanism as set forth in claim 7 in which the robot arm further comprises:

a fifth arm link having first and second end portion;

a sixth arm link having first and second end portion;

B14  
an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel a first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism

pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short

B14

link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint

B14

cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the additional center line, the second end portion of the first arm link and the first end portion of the third arm link connected with each other, the second end portion of the second arm link and the first end portion of the fourth arm link connected with each other, the first long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism substantially equal in length to each other, the first long link of the first joint cross linkage of the link retaining mechanism integrally formed with and in parallel relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the link retaining mechanism is connected with the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism;

a first stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the first arm link, the first link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the first arm link under the state that the first end portion of the first link of the first stabilizing parallelogram linkage is connected with the first end portion of the first arm link, a second link having first and second end portions and substantially equal in length to the fifth arm link, the

first and second links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the first stabilizing parallelogram linkage and the first end portion of the second link of the first stabilizing parallelogram linkage, the second link of the first stabilizing parallelogram linkage integrally formed with and in parallel relationship with the third arm link under the state that the first end portion of the second link of the first stabilizing parallelogram linkage is connected with the first end portion of the third arm link, a third link having first and second end portions and substantially equal in length to the first link of the first stabilizing parallelogram linkage, the second and third links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the first stabilizing parallelogram linkage and the first end portion of the third link of the first stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the first stabilizing parallelogram linkage, the third and fourth links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the first stabilizing parallelogram linkage and the first end portion of the fourth link of the first stabilizing parallelogram linkage, the fourth and first links of the first stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the fourth link of the first stabilizing parallelogram linkage and the first end portion of the first link of the first stabilizing parallelogram linkage under the state that the first link of the first stabilizing parallelogram linkage is in parallel relationship with the third link of the first stabilizing parallelogram linkage and that the second link of the first stabilizing parallelogram linkage is in parallel relationship with the fourth link of the first stabilizing parallelogram linkage, the fourth link of the first stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the fifth arm link under the state that the second end portion of the fourth link of the first stabilizing parallelogram linkage is connected with the first end portion of the fifth arm link; and

a second stabilizing parallelogram linkage comprising a first link having first and second end portions and substantially equal in length to the second arm link, the first link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the second arm link under the state that the first end portion of the first link of the second stabilizing parallelogram linkage is connected with the first end portion of the second arm link, a second link having first and second end portions and substantially equal in length to the sixth

arm link, the first and second links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the first link of the second stabilizing parallelogram linkage and the first end portion of the second link of the second stabilizing parallelogram linkage, the second link of the second stabilizing parallelogram linkage integrally formed with and in parallel relationship with the fourth arm link under the state that the first end portion of the second link of the second stabilizing parallelogram linkage is connected with the first end portion of the fourth arm link, a third link having first and second end portions and substantially equal in length to the first link of the second stabilizing parallelogram linkage, the second and third links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the second link of the second stabilizing parallelogram linkage and the first end portion of the third link of the second stabilizing parallelogram linkage, and a fourth link having first and second end portions and substantially equal in length to the second link of the second stabilizing parallelogram linkage, the third and fourth links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the third link of the second stabilizing parallelogram linkage and the first end portion of the fourth link of the second stabilizing parallelogram linkage, the fourth and first links of the second stabilizing parallelogram linkage pivotably connected with each other at the second end portion of the fourth link of the second stabilizing parallelogram linkage and the first end portion of the first link of the second stabilizing parallelogram linkage under the state that the first link of the second stabilizing parallelogram linkage is in parallel relationship with the third link of the second stabilizing parallelogram linkage and that the second link of the second stabilizing parallelogram linkage is in parallel relationship with the fourth link of the second stabilizing parallelogram linkage, the fourth link of the second stabilizing parallelogram linkage integrally formed with and in coaxial relationship with the sixth arm link under the state that the second end portion of the fourth link of the second stabilizing parallelogram linkage is connected with the first end portion of the sixth arm link.

22. (Twice Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:  
a fifth arm link having first and second end portion;



a sixth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel a first line and a second line, the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross

linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross

linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion

BB of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first joint mechanism retaining the fifth arm link at the second end portion of the fifth arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the third arm link, the second joint mechanism retaining the sixth arm link at the second end portion of the sixth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the fourth arm link.

25. (Twice Amended) A robot arm mechanism as set forth in claim 19 which further comprising an additional handling member, the robot arm further comprising:

BB a fifth arm link having first and second end portion;  
a sixth arm link having first and second end portion;  
a seventh arm link having first and second end portion;  
a eighth arm link having first and second end portion, the fifth and sixth arm links substantially equal in length to each other, the seventh and eighth arm links substantially equal in length to each other;

a third joint mechanism retaining the fifth and seventh arm links respectively at the second end portion of the fifth arm link and the first end portion of the seventh arm link under the state that the fifth arm link is pivotable around the second end portion of the fifth arm link with respect to the seventh arm link;

a fourth joint mechanism retaining the sixth and eighth arm links respectively at the second end portion of the sixth arm link and the first end portion of the eighth arm link under the state that the sixth arm link is pivotable around the second end portion of the sixth arm link with respect to the eighth arm link; and

an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the fifth and sixth arm links respectively at the first end portions of the fifth and sixth arm links and keeping parallel a first line and a second line,

the first line being a line passing through the first and second end portions of the fifth arm link and the second line being a line symmetrical line with respect to the additional center line with the line passing through the first and second end portions of the sixth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second

B16

end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the

first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the fifth and sixth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the fifth and sixth arm links integrally connected with the second long link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism respectively in coaxial relationship with the first long and short links of the second joint cross linkage of the additional link retaining mechanism, the additional center line substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and in perpendicular relationship with the first long link of the first joint cross linkage of the additional link retaining mechanism, the first end portions of the fifth and sixth arm links positioned on the line passing through the first and second end portions of the first long link of the first joint cross linkage of the additional link retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining

B1b

B16

mechanism, any one of the first and second driving shafts rotating the eighth arm link around the second end portion of the eighth arm link, the other one of the first and second driving shafts rotating the seventh arm link around the second end portion of the seventh arm link, the second end portions of the eighth and seventh arm links positioned on the rotation axis.

B17

28. (Twice Amended) A robot arm mechanism as set forth in claim 16 which further comprising an additional handling member, the robot arm further comprising:

- a third arm link having first and second end portion;
- a fourth arm link having first and second end portion, the first, second, third, and fourth arm links substantially equal in length to each other;
- a fifth arm link having first and second end portion;
- a sixth arm link having first and second end portion; and
- an additional link retaining mechanism having an additional center line, the additional link retaining mechanism pivotably retaining the third and fourth arm links respectively at the first end portions of the third and fourth arm links and keeping parallel a first line and a second line, the first line being a line passing through the first and second end portions of the third arm link and the second line being a line symmetrical with respect to the additional center line with the line passing through the first and second end portions of the fourth arm link, the additional link retaining mechanism comprising a first joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the first joint cross linkage of the additional link retaining mechanism, the first short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the first joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism and the second short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second short



link of the first joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the first joint cross linkage of the additional link retaining mechanism, the second short and long links of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second short link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism, the second long link of the first joint cross linkage of the additional link retaining mechanism and the first short link of the first joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism under the state that the second long link of the first joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the first joint cross linkage of the additional link retaining mechanism, and a second joint cross linkage including a first short link having first and second end portions, a first long link having first and second end portions and longer than the first short link of the second joint cross linkage of the additional link retaining mechanism, the first short and long links of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, a second short link having first and second end portions and substantially equal in length to the first short link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the second joint cross linkage of the additional link retaining mechanism and the second short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism, and a second long link having first and second end portions and substantially equal in length to the first long link of the second joint cross linkage of the additional link retaining mechanism, the second short and long links of the second joint cross linkage of the additional link retaining mechanism

pivotably connected with each other at the second end portion of the second short link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism, the second long link of the second joint cross linkage of the additional link retaining mechanism and the first short link of the second joint cross linkage of the additional link retaining mechanism pivotably connected with each other at the second end portion of the second long link of the second joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the second long link of the second joint cross linkage of the additional link retaining mechanism is crossed with the first long link of the second joint cross linkage of the additional link retaining mechanism, the length ratio of each of the first and second short links of the first joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the first joint cross linkage of the additional link retaining mechanism substantially equal to the length ratio of each of the first and second short links of the second joint cross linkage of the additional link retaining mechanism to each of the first and second long links of the second joint cross linkage of the additional link retaining mechanism, the first short link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first long link of the second joint cross linkage of the additional link retaining mechanism under the state that the second end portion of the first short link of the first joint cross linkage of the additional link retaining mechanism is connected with the first end portion of the first long link of the second joint cross linkage of the additional link retaining mechanism, the first long link of the first joint cross linkage of the additional link retaining mechanism integrally formed with and in parallel relationship with the first short link of the second joint cross linkage of the additional link retaining mechanism under the state that the first end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism is connected with the second end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the first end portion of any one of the third and fourth arm links integrally connected with the second short link of the first joint cross linkage of the additional link retaining mechanism, the first end portion of the other one of the third and fourth arm links integrally connected with the second long link of the second joint cross linkage of the additional link

retaining mechanism, the distance between the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism is substantially equal to the distance between the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism, the handling member having a first and second portions, the additional handling member having a first and second portions, the first arm link and the handling member pivotably connected with each other at the second end portion of the first arm link and the first portion of the handling member, the third arm link and the handling member pivotably connected with each other at the second end portion of the third arm link and the second portion of the handling member, the fourth arm link and the additional handling member pivotably connected with each other at the second end portion of the fourth arm link and the first portion of the additional handling member, the second arm link and the additional handling member pivotably connected with each other at the second end portion of the second arm link and the second portion of the additional handling member, the arm driving mechanism comprising a first driving shaft rotatable around a rotation axis, and a second driving shaft in the form of a hollow shape to rotatably receive therein the first driving shaft and rotatable around the rotation axis, any one of the first and second driving shafts rotating the fifth arm link around the second end portion of the fifth arm link, the other one of the first and second driving shafts rotating the sixth arm link around the second end portion of the sixth arm link, the second end portions of the fifth and sixth arm links positioned on the rotation axis, the fifth arm link pivotable around the second end portion of the fifth arm link, the sixth arm link pivotable around the second end portion of the sixth arm link, the first end portion of the fifth arm link pivotally connected with the first long link of the first joint cross linkage of the link retaining mechanism or the first short link of the second joint cross linkage of the link retaining mechanism under the state that the first end portion of the fifth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the link retaining mechanism, the first end portion of the sixth arm link pivotally connected with the first long link of the first joint cross linkage of the additional link retaining mechanism or the first short link of the second joint cross linkage of the additional link retaining

B17

B17

mechanism under the state that the first end portion of the sixth arm link is substantially equally spaced apart from the second end portion of the first long link of the first joint cross linkage of the additional link retaining mechanism and the first end portion of the first short link of the second joint cross linkage of the additional link retaining mechanism.

---